CHEMICAL & ENGINEERING NEWS

C&EN

JULY 13, 1992

PVC PRODUCERS STRUGGLE TO MAINTAIN PLANT OPERATING RATES PAGE 15

SALARY & EMPLOYMENT SURVEY

Continuing recession pushes joblessness among chemists a little higher, but salaries keep up with inflation

Page 38

BETHESDA MD 20814-3389
4420 EAST WEST HWY SUITE 800
SRI ACQUISITIONS
CONGRESSIONAL INFO SERV-SRI
0%111796092 9 K AR702BSL01 0339
5-DIGIT 20814 ********************

CHEMICAL & ENGINEERING NEWS

C&EN

JULY 13, 1992

NEWS OF THE WEEK

■ Fullerenes C_{60} and C_{70} have been found in an ancient carbon-rich rock from Russia, the first evidence that these compounds occur in nature. **Page 6**

■ U.S. appellate courts overturn EPA regulations allowing low levels of carcinogenic pesticides in foods, and throw out OSHA standards for workplace exposure to 428 toxic substances. **Page 7**

■ NASA launches spacecraft to gather data on energetic particles from the Milky Way galaxy and the Sun, and to probe the origin of anomalous cosmic rays. **Page 7**

■ People who drink chlorinated surface water are more at risk for developing bladder and rectal cancer than those who do not, according to a recent study. **Page 7**

■ Hoechst and Petrofina plan to swap U.S polymer assets producing high-density polyethylene and dimethyl terephthalate. **Page 8**

COVER: Photo by Clark Dunbar, Uniphoto Picture Agency

Volume 70, Number 28
CENEAR 70 (28) 1–64
ISSN 0009-2347

BUSINESS

Market for polyvinyl chloride shows some signs of recovery following low demand of past few quarters, but producers now face new capacity and an expected summer slowdown. **Page 15**

European Chemical Industry Council implements plan to transfer environmental and energy-saving technology to chemical industries in East European countries. **Page 17**

GOVERNMENT

A proposed strategic plan for NIH was wrestled with at a recent meeting by a task force of working scientists and research administrators, and is expected to be ready by summer's end. **Page 20**

Superconducting Super Collider is fighting to stay alive, with the House voting to cut SSC funding from the fiscal 1993 budget and the upcoming Senate vote likely to be close. **Page 21**

SCIENCE/TECHNOLOGY

Silico-titanates, new materials that extract cesium-137 from solutions with high salt concentrations, show promise for cleaning up radioactive wastes. **Page 26**

Centers for Disease Control is offering grants for development of new or improved technology to measure concentrations of lead in whole blood. **Page 27**

EDUCATION

Test aid relieves exam anxiety for college chemistry students—for a price of points, they can scratch off coating to reveal clues to solving examination problems. **Page 37**

SALARY SURVEY

Lingering recession continues to hurt the job market for chemists, with the 1.9% jobless rate at highest level since 1983; conversely, salary increases have more than kept up with inflation. Page 38

LETTERS 4

CONCENTRATES

Business 13

Government 19

Science/Technology 25

THE DEPARTMENTS

Software/ Database Update 28

Awards 48

Meetings 49

ACS News 62

Newscripts 64

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036
Editor: Michael Heylin (202) 872-4501
Assistant Managing Editors: James H. Krieger, Janice R. Long, Rebecca L. Rawls, Donald J. Soisson, William J. Storck
Staff Editor: Ernest L. Carpenter
Senior Correspondents: Earl V. Anderson, Lois Ember, Wilbert C. Lepkowski
News Editor: Richard J. Seltzer
Senior Editors: New York: Stephen C. Stinson; Chicago: Joseph Haggin; London: Patricia L. Layman; Washington: Stuart A. Borman, Mairin B. Brennan, Doron Dagani, Bette Hileman, Pamela S. Zurer
Associate Editor: Ann Marie Menting
Assistant Editor: Jane K. Baker
Service Departments Editor: Dolores Miner
Editing Services: Arlene Goldberg-Gist (Head), Rita E. Johnson (Editorial Assistant), Patricia Oates (Administrative Assistant)
News Bureaus: Northeast News Bureau: (908) 906-8300 Ann M. Thayer (Head), Marc S. Reisch (Associate Editor), Rachel Eskenazi (Administrative Assistant). Houston: (713) 984-8162 Susan J. Ainsworth (Associate Editor). Washington: (202) 872-4495 David J. Hanson (Head). West Coast: (510) 653-3630 Rudy M. Baum (Head). **Foreign Bureau:** London: (01) 540-0414 Dermot A. O'Sullivan (Head)
Graphics and Production: Leroy Corcoran (Head). Barbara Fryer (Art Director). Linda Mattingly (Staff Artist). Diane Kelly (Costing)
Composition Systems Administrator: Vincent L. Parker. **Assistant:** Robin L. Shapiro
Business Manager: Arthur Poulos
Circulation Director: David Schulbaum
ADVISORY BOARD: F. Peter Boer, George Castro, Jerry Caulder, P. M. Chakrabarti, Peter B. Dervan, Renée G. Ford, Louis J. Glunz, Kenneth G. Hancock, Harry S. Hertz, Stephen J. Lippard, Cynthia A. Maryanoff, Linda B. McGown, James N. Pitts Jr., Douglas J. Raber, Bassam Z. Shakhashiri, David A. Shirley, Charles S. Tuesday, Theodore R. Williams
Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-4432
John Kistler Crum, Executive Director
Robert H. Marks, Director, Publications Division
PUBLISHING BOARD: Ned D. Heindel *(Chairman); Board of Directors Chairman:* Joseph A. Dixon; *President:* Ernest L. Eliel; Richard L. Deming; Judith C. Giordan; William P. Jencks; and Gary J. Long
Subscription & Member Record Service: Send all new and renewal subscriptions with payments to: ACS, Dept. L-0011, Columbus, Ohio 43268-0011. Correspondence and telephone calls for changes of address, claims for missing issues, subscription orders, status of records and accounts should be directed to: Manager, Member & Subscriber Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; (800) 333-9511 or (614) 447-3776.

For changes of address, include both old and new addresses with ZIP code numbers and mailing label from a recent issue. Allow four weeks for change to become effective. Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign: more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1992: Printed editions: nonmembers U.S. 1 yr. $105, 2 yr. $189; outside U.S. 1 yr. $141, 2 yr. $261. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3–10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $15. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

Advertising Management: CENTCOM LTD.
(For list of offices *see* page 63)
Office of Ombudsman: (800) ACS-5558, No. 8–5
© Copyright 1992, American Chemical Society
Canadian GST Reg. No. R127571347

LETTERS

CHEMICAL SAFETY

Triphosgene warning

Triphosgene is a conveniently used solid-phase form of phosgene sold by Aldrich Chemical Co. Inc. This reagent is finding wide use in synthetic applications involving formation of ureas, chloroformates, isocyanates, and other related compounds. As a solid with low volatility, it is much safer to handle than phosgene itself and has been marketed for its excellent transport, storage, and manipulation characteristics (for example, see the back cover of *J. Org. Chem.*, June 21, 1991).

Last autumn, Aldrich was selling research quantities of triphosgene in paraffin-sealed bottles packed in vermiculite inside sealed metal cans. We were surprised when, upon puncturing the top of the can with a can opener, there was a fairly loud hiss that lasted for approximately two seconds. Subsequent examination of the bottle revealed that the cap had been cracked. We suspect that the escaping gas was phosgene, which had been formed by reaction of triphosgene with small amounts of water trapped in the vermiculite.

Phosgene is a well-known war gas. The lowest published concentration that is lethal to humans (inhalation) is 50 ppm for five minutes. Short-term exposure limits have been established at 1 ppm for five minutes. This compound is especially insidious because severe symptoms can arise even if the exposed person does not smell the gas. Although the metal can contained standard warnings concerning the toxicity and respiratory hazards of triphosgene, there were no indications that the contents of the can were packaged in such a way that might allow pressure to develop.

Our phone call to Aldrich revealed that two other similar incidents had occurred within the past two years, and that cans that are not opened shortly after receipt could develop significant pressures. Because of these problems, Aldrich now seals its triphosgene bottles in plasticized aluminum pouches inside vermiculite-filled cans. These cans are now marked, "Keep Refrigerated." Cans of triphosgene purchased either last year or earlier this year, and which do not contain the "Keep Refrigerated" warning, should be treated with extreme caution.

Mark D. Hollingsworth
Department of Chemistry
Indiana University
Bloomington

Aldrich introduced triphosgene as a convenient phosgene substitute. We have been selling this product in research quantities since 1987. During that time, we have made several packaging changes to enhance the safety factor during shipping and handling. We take our customers' complaints and concerns seriously and attempt to incorporate all appropriate suggestions into our packaging program. We believe that the best warning advice is to state on the bottle and package: "Open and handle only with gloves in hood."

We will implement this change immediately and notify our past customers. As you are aware, no simple warning will adequately cover all hazards and situations. Therefore, we strongly recommend that individuals who intend to work with this or any chemical with which they are not totally familiar, should first read the material safety data sheet and then handle the chemical with the proper recommended equipment and protection in place.

We appreciate Mark Hollingworth's efforts in bringing this matter to the attention of the chemical community. We at Aldrich operate under the philosophy of always striving to offer the most versatile reagents available in the safest manner possible.

Kenneth J. TerBeek
Manager, Environmental, Safety, Health, and Regulatory Affairs
Aldrich Chemical Co. Inc.
Milwaukee

Authorization to photocopy any article for internal or personal use beyond the fair use provisions of the Copyright Act is granted by ACS to libraries and other users registered with the Copyright Clearance Center (CCC), provided that the fee of $3.00 per article copy is paid directly to CCC, 27 Congress St., Salem, Mass. 01970, USA. Copying for other than internal or personal use without express permission of ACS is prohibited. Address requests for customized bulk reprints to ACS Copyright Administrator, 1155—16th St., N.W., Washington, D.C. 20036, or call (202) 872-4367. The CCC Code for C&EN is 0009-2347/92 $3.00.

Job Market for Chemists Weakens, Salaries Hold Up Quite Well

ACS survey puts jobless rate for chemists at highest level in nine years, indicates above-inflation salary gains

Michael Heylin, C&EN Washington

This year's American Chemical Society survey of the salaries and employment status of its members has produced the usual mind-boggling array of data that many chemists apparently like to pore over either out of curiosity or in a quest for nuggets of information to support their own career aspirations.

The survey analyzes salaries of chemical professionals seemingly every which way. These include by gender, highest degree, percentile, years since receiving B.S. degree, age, type of employer, size of employer, and work function. The study is equally diligent in dissecting the employment situation.

But the bottom line of this year's survey, taken as of March 1, is confirmation of what chemists have known for some time—that the lingering recession has made the employment situation for chemical professionals less secure than it has been in almost a decade. On the brighter side, the survey reveals that salary increases for chemists over the past year more than kept up with inflation.

Of those responding to the survey, 1.9% were without jobs, but seeking employment. This is the highest level of unemployment in the chemical profession since 1983, when it was 2.2%.

The survey also indicates a median salary for Ph.D.s that is 3.4% higher than a year earlier. Bachelor-level chemists posted a 4.3% gain. Chemists with M.S. degrees did a little better, with a boost of 5.5%. These gains exceeded the 3.2% rise in the consumer price index for urban consumers between March 1991 and March 1992.

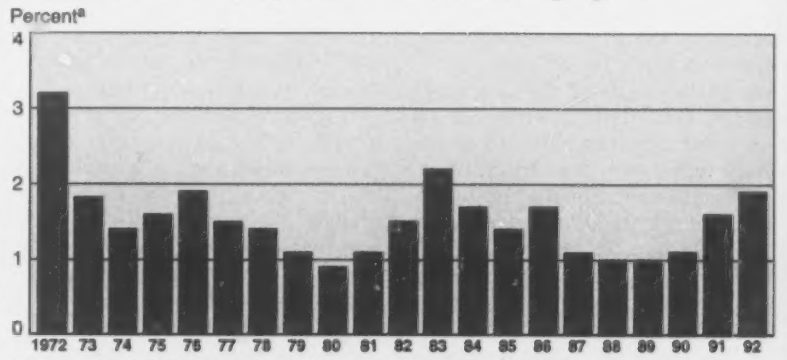
The survey this year involved mailing questionnaires to 20,000 ACS members living in the U.S. who were not more than 70 years old and neither students nor on retired status. It was directed by Joan S. Burrelli of ACS's Office of Professional Services.

Slightly more than 12,000, or 60%, responded to the survey. Of these, 62% were employed by industry, 25% were academics, 8% were government employees, and 5% worked for a variety of other organizations. By degree, 59% held Ph.D.s, 24% bachelor's, and 17% master's. By gender, 20% were women. By race 87.6% were white, 8.6% Asian, 1.5% Hispanic, 1.3% black, 0.4% Native American, and 0.6% "other."

As has been the case for many years, the rate of unemployment among ACS members is apparently well below more general indicators of joblessness. The 1.9% rate revealed by the latest survey for March 1 of this year compares with government data indicating a 7.3% unemployment rate for all civilian workers and a 2.9% rate for those with a managerial or professional specialty.

However, even relatively slight year-to-year movements in the unemployment rate determined by ACS's annual surveys indicate considerable change in the actual job situation for chemists. During prosperous times the ACS fig-

Number of unemployed chemists moves up again



a Unemployed, but seeking employment, as of March 1 each year. **Source:** ACS survey

Government offers most stable employment for chemists

	Employed[a]			Seeking employment
	Full time	Part time	Postdoc	
EMPLOYER				
Industry	96.6%	0.9%	0.3%	2.1%
Academia	88.0	3.1	7.6	1.3
Government	94.1	2.0	3.1	0.9
Other nonacademic	81.0	12.9	2.4	3.7
MOST RECENT WORK				
Production	97.5	0.6	0	1.9
R&D management	97.3	1.0	0.1	1.6
General management	97.1	1.0	0.1	1.7
Marketing	95.2	1.3	0	3.5
R&D	91.1	1.2	5.8	1.9

a As of March 1, 1992. **Source:** ACS survey

Women, minorities, and Ph.D.'s are least likely to be employed full time

Employment status[a]	Chemists								Chemical engineers
	Total	By sex		By highest degree			By minority status		
		Men	Women	B.S.	M.S.	Ph.D.	Minority[b]	Nonminority	
Employed full time	91.8%	93.3%	86.0%	92.7%	92.7%	91.2%	88.2%	92.3%	91.7%
Employed part time	2.2	1.4	5.4	2.1	2.6	2.2	1.4	2.3	3.4
Postdoctoral or fellowship	2.4	2.2	3.1	0.2	0.2	3.9	7.6	1.6	0.3
Unemployed									
Seeking employment	1.9	1.8	2.4	2.3	2.0	1.7	1.9	1.9	2.8
Not seeking employment	1.7	1.4	3.1	2.6	2.5	1.1	0.9	1.8	1.8

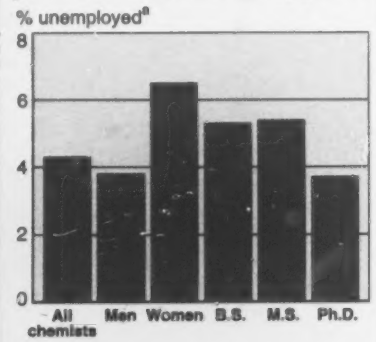
a As of March 1, 1992. b Black, Spanish/Hispanic, Native American, Alaskan native, Asian, Pacific Islander, or other. **Source:** ACS survey

Percentage of chemists employed full time is at lowest level in the decade

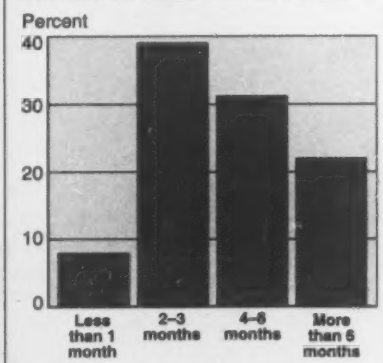
Employment status[a]	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
Employed full time	93.4%	94.0%	95.2%	95.3%	95.4%	95.4%	94.8%	95.2%	93.7%	93.5%	94.9%
Employed part time	2.2	1.8	1.4	1.5	1.6	1.5	1.5	1.5	1.7	1.7	1.4
Postdoctoral or fellowship	2.4	2.6	2.2	2.2	2.0	2.0	2.0	1.9	2.9	2.6	2.2
Unemployed	1.9	1.6	1.1	1.0	1.0	1.1	1.7	1.4	1.7	2.2	1.5

a As of March 1, 1992; excludes chemists who are not employed but not seeking employment. **Source:** ACS survey

More than 4% of chemists jobless sometime in 1991...



...nearly one in four for more than six months



a Unemployed at sometime between March 1, 1991, and March 1, 1992. **Source:** ACS survey

ure hovers very close to 1.0%. The lowest it has been in the past 20 years was 0.9%, in 1980. The recession in 1972, which affected the chemical profession very badly, pushed it to a seemingly still quite modest 3.2%. This year's 1.9% reflects a considerable, but less severe, downturn for the chemical professional—as did the 2.2% rate for 1983, another recession year.

The survey also indicates that 4.3% of respondents were jobless at some time between March 1991 and March 1992. This compares with 3.1% during the previous 12 months. Of the unemployed between March 1991 and March 1992, slightly more than half, 53%, were out of work for more than three months. Of women respondents, 6.5% were unemployed at some time during these 12 months. This compares with 3.5% for men.

Other data from the survey also confirm a generally weaker employment situation for women. For instance, only 89% of women either with a job or seeking a job were employed full time as of March 1. This compares with almost 95% of the men. Significantly more women than men were unemployed, 2.4% verus 1.8%. And a higher proportion of women than men were employed part time—5.4% compared to 1.4%.

By degree, B.S. chemists were considerably more likely to be unemployed, 2.3%, than were Ph.D.s, 1.7%. By previous employer, those from industry were most likely to be jobless, 2.1%. This compares with 0.9% of government workers and 1.3% of academics.

The overall message from the salary data from the new survey, as from previous surveys, is that those who want to work in chemistry but also want to maximize their salaries should plan for a long career, earn a Ph.D., obtain a job in industry, and manage something. It also helps to be male, but less so than it once did, especially for younger workers. This scenario reflects the major determinants of chemists' salaries—experience, highest degree, type of employer, job function, and gender.

These factors overlap considerably. For instance, older ACS members are much more likely to be Ph.D.s than are younger members. Women chemists as a group are younger, less experienced, and less likely to hold advanced degrees than their male colleagues—all factors that depress their overall median salary.

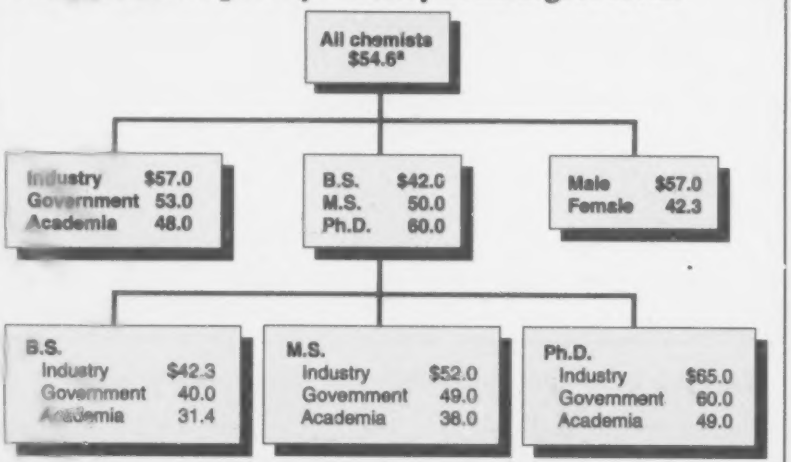
The salary data in the survey, unless otherwise stated, are medians of the base salary from the principal job of respondents employed full time. They exclude bonuses, overtime, and additional professional income, such as from consulting. Medians are used because they are distorted less by the rel-

atively few extremely high salaries than are means. For instance, the mean salary for all B.S. respondents to the survey was about $5000 higher than the median. This differential at the M.S. and Ph.D. levels was about $4000.

The gross salary medians indicate that Ph.D.s earn $60,000, 43% more than B.S. chemists, who earn $42,000; that chemists in industry earn almost 19% more than academics, $57,000 versus $48,000; and that men earn a hefty 35% more than women, $57,000 versus $42,300.

However, more detailed breakdowns reveal less extreme differences. For instance, the median salary of $65,000 for industrially employed Ph.D. chemists is 53% higher than the $42,300 median for bachelor-level chemists also employed in industry.

Chemists better paid by industry at all degree levels



a Median base annual salaries in thousands of dollars as of March 1, 1992. **Source:** ACS survey

Median salaries for chemists reach $60,000 for those with Ph.D.s, $50,000 for master's

$ Thousands	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	% annual change 1991–92	1987–92	1982–92
CHEMISTS' MEDIAN SALARIES[a]														
B.S.	$42.0	$40.3	$39.0	$37.0	$35.4	$33.5	$33.0	$32.0	$30.9	$30.0	$28.5	4.2%	4.6%	4.0%
M.S.	50.0	47.4	45.0	43.0	41.0	39.0	37.9	36.0	34.0	33.0	31.6	5.5	5.1	4.7
Ph.D.	60.0	58.0	55.0	52.5	50.0	47.7	47.8	44.0	42.0	40.0	37.5	3.4	4.7	4.8
All chemists	54.6	52.0	49.8	47.3	45.0	42.5	42.5	40.0	38.0	36.0	34.7	5.0	5.1	4.6

a Base annual salary of chemists employed full time as of March 1, 1992. **Source:** ACS survey

Top 10% of Ph.D. industrial chemists earn over $100,000 after working about 20 years

Median salary, $ thousands[a]	Years since B.S. degree: 0 to 1	2 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more	Overall
INDUSTRIAL CHEMISTS											
B.S.											
90%	$36.0	$39.7	$48.6	$58.0	$65.0	$83.0	$ 86.0	$ 87.0	$109.6	$120.0	$70.0
75%	32.0	35.2	42.0	49.4	57.5	65.0	70.0	72.0	80.0	85.0	55.0
50%	29.0	32.0	37.0	42.3	48.0	54.5	56.0	58.0	60.0	65.0	42.4
25%	22.3	27.8	32.0	37.0	41.0	45.0	46.5	48.6	50.0	54.0	35.0
10%	20.3	24.2	28.0	32.0	34.7	38.1	39.0	36.0	41.0	40.0	29.2
M.S.											
90%	—	—	49.0	65.0	76.0	81.0	89.0	92.9	105.3	88.0	79.7
75%	—	—	44.9	55.0	62.0	68.0	70.0	67.0	83.0	79.7	64.0
50%	—	—	40.0	46.0	53.2	59.4	60.0	59.9	65.0	67.8	52.0
25%	—	—	36.1	41.0	46.1	49.0	50.0	48.3	53.0	55.0	43.0
10%	—	—	33.0	36.0	40.0	41.7	45.0	42.5	43.0	48.0	36.3
Ph.D.											
90%	—	—	58.0	70.0	80.5	95.6	106.0	130.0	125.0	126.0	97.0
75%	—	—	55.0	62.0	72.0	81.4	91.5	96.0	96.0	103.0	80.0
50%	—	—	52.0	56.9	63.5	70.0	76.0	79.0	80.0	85.0	65.0
25%	—	—	48.1	52.0	58.0	60.3	66.8	67.0	67.0	67.5	56.0
10%	—	—	44.0	47.0	51.0	53.0	58.8	56.8	56.1	54.0	49.8

How to read this table: Using, as an example, industrial B.S. chemists two to four years after they have received their B.S. degree, 90% of these chemists have annual base salaries of $39,700 or less; 75% have annual base salaries of $35,200 or less, 50% have annual base salaries of $32,000 or less, 25% have annual base salaries of $27,800 or less, and 10% have annual base salaries of $24,200 or less, as of March 1, 1992. a As of March 1, 1992. **Source:** ACS survey

Salaries of women chemists in industry seem to plateau after about 15 years on the job

Median salary, $ thousands[a]		Years since B.S. degree									
		2 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more	Overall
CHEMISTS EMPLOYED FULL TIME IN INDUSTRY											
Total											
B.S.		$32.0	$37.0	$42.3	$48.0	$54.5	$56.0	$58.0	$ 60.0	$ 65.0	$42.4
M.S.		35.0	40.0	46.0	53.2	59.4	60.0	59.9	65.0	67.8	52.0
Ph.D.		—	52.0	56.9	63.5	70.0	76.0	79.0	80.0	85.0	65.0
Sex											
Men	B.S.	31.7	38.2	43.6	48.4	56.4	57.8	59.1	63.0	65.4	45.7
	M.S.	—	40.0	46.8	54.0	59.7	60.5	60.0	65.5	68.8	54.0
	Ph.D.	—	52.0	57.0	63.5	70.3	76.8	80.0	80.0	85.0	67.0
Women	B.S.	32.5	36.0	39.5	46.0	44.0	48.0	50.0	—	—	37.0
	M.S.	—	40.0	43.5	52.7	55.9	56.0	50.0	—	—	45.0
	Ph.D.	—	51.5	55.6	63.7	65.0	70.0	—	—	—	58.0
Work function											
General management	B.S.	—	39.0	49.4	56.5	58.5	80.4	67.0	—	—	56.5
	M.S.	—	—	—	60.6	62.5	—	—	—	—	63.0
	Ph.D.	—	—	—	69.7	90.0	81.5	89.1	101.0	—	83.5
R&D management	B.S.	—	38.0	47.5	55.5	70.0	—	70.7	—	—	56.9
	M.S.	—	—	58.0	64.5	65.0	74.1	72.0	—	—	67.0
	Ph.D.	—	—	66.6	72.0	81.0	92.0	85.0	91.0	103.5	81.0
Basic research	B.S.	34.6	36.3	39.9	45.0	—	—	—	—	—	38.6
	M.S.	—	40.8	44.9	47.5	—	—	—	—	—	45.0
	Ph.D.	—	53.0	58.2	64.5	69.5	75.0	80.8	75.0	—	61.1
Applied research	B.S.	33.0	37.5	42.5	49.0	53.2	53.3	54.5	56.7	—	42.0
	M.S.	—	41.8	45.0	52.5	56.0	52.5	60.0	65.0	—	49.7
	Ph.D.	—	51.0	56.0	62.0	65.0	70.0	72.0	75.5	68.8	60.0
Production	B.S.	—	40.0	48.0	53.5	65.0	—	—	—	—	50.0
	M.S.	—	—	49.5	59.5	66.6	—	—	—	—	55.1
	Ph.D.	—	—	53.9	—	—	70.5	68.8	—	—	66.3
Marketing	B.S.	31.0	35.8	41.1	42.0	50.0	46.8	—	53.7	—	39.3
	M.S.	—	38.3	39.0	55.0	54.0	—	—	—	—	48.0
	Ph.D.	—	—	51.3	54.5	—	69.1	—	—	—	57.6

Note: Where no salary data are shown, sample is too small (less than 15) to provide meaningful figure. a As of March 1, 1992. **Source:** ACS survey

But when the comparison is between those of the same age, this salary differential drops to about 34%.

Similarly, the seeming 35% salary advantage for male chemists is substantially a result of their greater average age, higher degree level, and more experience. After adjustment for these factors, this salary differential generally falls into the 5 to 15% range.

A more detailed analysis of data from chemists employed by industry indicates that the median salaries of men and women Ph.D.s remain essentially the same up until about age 45 (15 to 19 years after the B.S.). For older age groups, the salary medians tend to plateau for women. But for men they show sizable further gains. The pattern is similar for industrial M.S. and B.S. chemists, with salary differences between men and women becoming increasingly apparent in the older age groups.

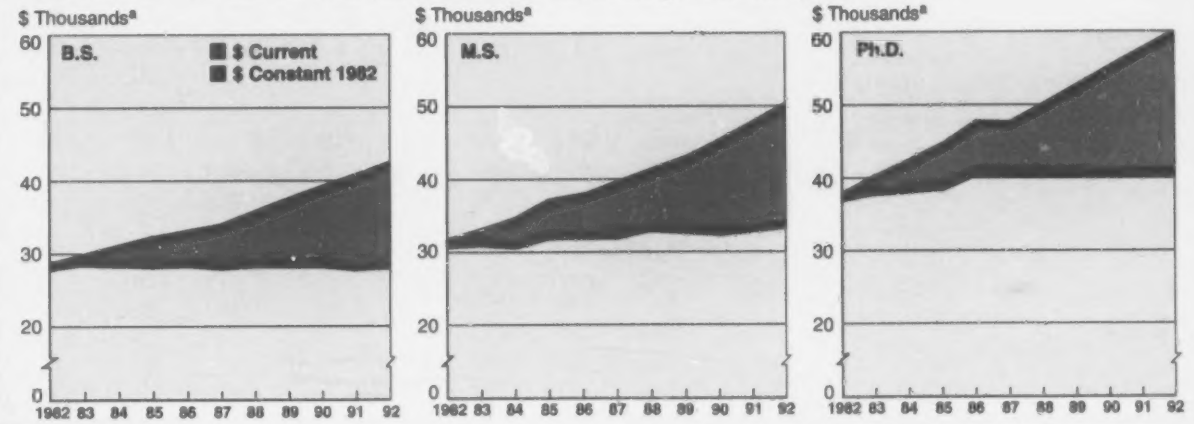
The analysis of industrial salaries by

Salary gap between men and women chemists is generally smaller in government

Mean salary, $ thousands[a]	B.S.				M.S.				Ph.D.			
	All chemists	Men	Women	Women as % of men	All chemists	Men	Women	Women as % of men	All chemists	Men	Women	Women as % of men
EMPLOYER												
Private industry	$47.4	$50.5	$43.3	86%	$55.5	$57.3	$54.3	95%	$71.1	$72.4	$63.8	88%
Academia	34.6	35.7	34.2	96	39.4	42.3	35.7	85	53.8	55.9	45.4	81
Government	42.5	44.5	42.5	96	49.2	52.4	45.8	87	61.7	63.1	57.3	91
Other	53.4	60.0	41.6	78	59.5	63.6	47.0	74	71.2	73.3	53.3	73

a As of March 1, 1992; to facilitate comparison, women's salaries are adjusted for the difference in average length of experience between them and men. **Source:** ACS survey

Constant-dollar salaries for B.S. chemists have stagnated for past 10 years



Note: Average salary increases for individual chemists have been larger because of increasing experience. a Median base annual salary for chemists employed full time as of March 1 of each year. **Source:** ACS survey

job function confirms that general managers and R&D managers have the edge. For Ph.D.s, medians of $83,500 for general managers and $81,000 for R&D managers compare with $60,000 for Ph.D.s in applied research and $61,100 for those in basic research. Part of this differential between management and research may be due to age. Older Ph.D.s tend to move out of research—at least [illegible] R&D management. Those who do stay at the bench apparently don't do too badly. For instance, Ph.D. chemists still in basic research 30 to 34 years after receiving their B.S. degrees have a median salary of $80,800. This compares with $89,100 for their contemporaries in general management.

The latest survey also indicates that the size of industrial employers had an impact on salaries. Larger firms apparently pay more. Companies with 25,000 or more employees pay their chemists about 15% more than do firms with less than 500 employees.

The difference in median salaries for Ph.D.s in industry, $65,000, and in academia, $49,000, is also deceptively large. A considerable number of academics have nine- or 10-month contracts and earn additional income from their summer activities that is not included in the ACS data. Also, the median salary of $85,000 for full professors at Ph.D.-granting institutions compares well with that for Ph.D. managers in industry.

Data from the survey indicate that professional income in addition to basic salary from principal job—such as from bonuses, overtime, summer work, or consulting—averaged $6600 for all respondents. However, distribution of this income was very skewed. More than 40% of respondents received no such income, whereas those in the highest 10 percentile received $15,500 or more. The median was $1500. The mean for B.S. chemists was $5200. But the median was only $500. Such income was higher for doctoral chemists with a mean of $7600 and a median of $2100.

In general, the salaries of chemists employed in government fall between those of their colleagues in industry and academia—if somewhat closer to the industry level.

Biggest salary gains for chemists come in first 20 years of career

Median salary, $ thousands[a]	Years since B.S. degree									Overall median
	2 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more	
ALL CHEMISTS	$31.5	$40.0	$48.0	$55.0	$60.0	$63.4	$63.0	$66.0	$66.0	$54.6
By sex										
Male	31.3	41.5	50.0	55.5	61.0	66.0	65.0	68.0	68.9	57.1
Female	32.0	38.0	42.0	50.8	50.0	49.0	50.0	51.2	49.7	42.4
By degree										
B.S.	31.2	36.9	42.0	47.0	52.0	55.6	55.7	60.0	62.2	42.0
M.S.	—	39.0	45.0	52.7	54.4	56.0	53.0	58.0	58.0	50.0
Ph.D.	—	50.0	53.5	59.7	63.7	68.0	68.0	70.0	70.0	60.0
By employer										
Industry	32.2	42.0	52.0	59.0	64.2	70.0	71.0	73.0	75.0	57.0
Government	—	37.0	42.5	49.3	51.5	60.0	62.2	68.7	64.9	53.0
Academia	—	31.1	36.5	41.0	45.0	51.6	55.0	57.0	60.0	47.9

a As of March 1, 1992. **Source:** ACS survey

Very Special GMP Chemistries

For intermediates and active substances

KG ▶ TON ▶ BULK

REACTIONS
- Low Temperature:
  - Cryogenic
  - Pyrophoric
- Hydrogenation: Up to 300 bar/300°C
- Grignard/Alkyl Lithium
- Reductions:
  - Electrolytic
  - Metal Hydride
  - Birch
  - Borane
- Caustic Fusion
- Phosgenation
- Hydrogen Sulfide

CHEMISTRIES
- Small Cyclic
- Peptide
- Imidazole
- Carbohydrate:
  - Isopropylidene Sugars
  - Deoxyfluoro Nucleosides
  - Benzeneboronic Acids
- Tetrazole
- Phospholipid
- Organo Silane
- Chiral:
  - Enzymatic/Fermentation
  - Asymmetric Synthesis
- Steroid

FDA INSPECTED FACILITIES
• Qualification Batches • Full Scale Production

Process Research and Development

From the U.S., Canadian, European and Japanese custom manufacturers we represent, Davos can offer a wide range of technologies to address your specific custom synthesis requirements.

DAVOS CHEMICAL CORPORATION
140 Sylvan Ave., Englewood Cliffs, NJ 07632
(201) 461-5910 • FAX (201) 461-5176

CIRCLE 15 ON READER SERVICE CARD

FORGET IT.

The last thing you want is a precision metering pump that you have to fuss over.

That's not a problem when you buy an Eldex.

NO FUSS

First of all, we've got about every kind of pump to match your application, including metal-free designs. With flow rates from 0.025 to 100mL/min, at pressures up to 5,000 psi. In fact, we have more models at reasonable prices than any other precision metering pump manufacturer.

NO MESS

Our pumps are so reliable that they'll accurately meter fluids for years—even under stringent conditions.

Plus, they're easy to maintain. With some pumps, changing a seal is a big production. With ours, it takes less than a minute. And that's about all you have to do!

So you can forget about the pump and focus on your work. To order or learn more, give us a call.

Tel: **1-800-969-3533**
Fax: 1-415-592-5028

Eldex Precision Equipment for Chromatography

© Eldex Laboratories, Inc. 1991

CIRCLE 44 ON READER SERVICE CARD

In industry, managers have large salary edge

Median salary, $ thousands[a]	By degree B.S.	M.S.	Ph.D.
R&D management	$56.9	$66.0	$80.9
General management	56.4	63.0	83.5
Marketing	50.0	55.1	66.3
Applied research	42.0	49.6	60.0
Production	38.5	47.8	57.6
Basic research	38.5	45.0	61.1

a As of March 1, 1992. Source: ACS survey

Bigger industrial firms tend to pay chemists more

Median salary, $ thousands[a]	By degree B.S.	M.S.	Ph.D.
NUMBER OF EMPLOYEES			
Less than 500	$40.0	$50.0	$60.0
500 to 2499	42.5	49.7	62.5
2500 to 9999	44.0	51.6	66.0
10,000 to 24,999	46.0	53.0	65.0
25,000 or more	46.6	56.0	69.9

a As of March 1, 1992. Source: ACS survey

Full professors at top schools do well

Median salary, $ thousands[a]	9- to 10-month contracts: Non-Ph.D. school	9- to 10-month contracts: Ph.D. school	11- to 12-month contracts: Non-Ph.D. school	11- to 12-month contracts: Ph.D. school
Full professor	$49.5	$61.0	$67.3	$85.0
Associate professor	38.2	43.3	56.9	54.6
Assistant professor	32.0	37.2	40.9	45.0

a As of March 1, 1992. Source: ACS survey

The full report on this year's ACS survey, "Salaries 1992," will be available in August at $150 per copy. It can be purchased from the ACS Distribution Office, Room 210, American Chemical Society, 1155—16th St., N.W., Washington, D.C. 20036.

Questions or comments should be directed to Joan Burrelli at (202) 872-4433. □